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EFFECT OF PERCEPTUAL TRAINING ON INTELLIGENCE AND ACHIEVEMENT.

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THE PERCEPTUAL-MOTOR BEHAVIOR IN LEARNING WAS STUDIED IN RELATIONSHIP TO INTELLIGENCE AND SCHOOL ACHIEVEMENT. THE SAMPLE CONSISTED OF 178 THIRD-GRADE PUPILS, WHO WERE MATCHED ON RACE, SEX, INTELLIGENCE AND ACHIEVEMENT, RESULTING IN FOUR EQUIVALENT GROUPS. TRAINING METHODS INCLUDED BLOCKS, PUZZLES, AND READING. POST-TEST PROCEDURES WERE EMPLOYED UPON COMPLETION OF THE PROGRAM. ANALYSES WERE MADE BY ANALYSIS OF VARIANCE. THE RESULTS INDICATED THAT THE GREATEST GAINS MADE WERE IN GROUPS RECEIVING THE READING AND BLOCK TREATMENTS. (RS)

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EFFECT OF PERCEPTUAL TRAINING ON INTELLIGENCE AND ACHIEVEMENT

Cooperative Research Projects No. S-060

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Problem

Before a student correctly names words, understands the written word, translates verbal symbols to the more abstract mathematical ones, and with speed and accuracy performs arithmetic operations, he must not only unerringly identify signs but discriminate them from others similar in form, must habitually decode symbol groupings in a left to right direction, must skillfully organize a task according to a time sequence, and must have the ability to respond to reduced cues in a general configuration. A factor analytic study of perception by Thurstone (1944) revealed several functional rather than purely ocular attributes associated with perception. Among these were, 1. perceptual closure against some distraction, 2. alternation effects, 3. simultaneous manipulation of more than one configuration, 4. speed of perception, 5. speed of judgment and, 6. general intelligence. Thurstone's subjects were older adolescents. Goins (1958) studying first grade children observed loadings on two attributes emerging from her factor analytic study. One was the ability to hold in mind a perceived configuration, the other was the ability to keep in mind this configuration against distraction.

Years earlier, questions were raised concerning the generality of a perceptual factor in reading. Gates (1922) submitted there was no general factor. Fendrick (1935) and Langsam (1941) speculated independently from their data that such a factor existed. Interpreters of studies of reading frequently have seen analogs between research results and the theoretical formulations in Gestalt Psychology. Renshaw (1945) explained the progress subjects made in tachistoscopic perceptual training as being due to the "perceptual skill of field structuring."

While there is but suggestive evidence for functional unities among many tests of perception, there have been concerted efforts to train children to alter their perceptions. Germane to the present study are studies initiated by Kephart (1940), Jolles (1958), Strauss and Lehtinen (1947), and Goins (1958). Kephart's program

was a very general one involving exposing mental retardates to varied physical and social stimuli. Jolles' program involved pegboards and parquetry blocks. Strauss and Lehtinen used procedures involving copying directional lines, patterns, and alphabet letters. Goins used tachistoscopic training with first graders. Kephart inferred that changes in intelligence quotients resulted from the stimulation in the rehabilitation program; Goins, on the other hand, found no change in reading achievement in the first graders she trained. The reasons that a generalization concerning these programs is prohibitive is that the several training programs not only differ in kind but investigations on their effects have been upon diverse populations and upon a variety of dependent variables. Therefore, it is too early to achieve rapprochement between the studies.

Training is a set of behavioral operations which takes place in an environment. Environments, it is well known, differ in type of organization as well as in stimulation. Lee (1951) presented data which indicated that Negro children raised in the South who moved to Philadelphia increased in intelligence quotients over a period of years whereas Philadelphia born Negroes changed little. The increase, moreover, was linked to the age of arrival at Philadelphia. This is an example of a dramatic change in environment. Also it deals with environment in gross terms. A more specific, but still inarticulate, definition of environment is contained in Kirk's (1958) study. Institutionalized mentally retarded children were raised under conditions varying in opportunities to manipulate objects, to observe, and to receive feedback. Those children who had been in the environment more favorable to learning increased in I. Q. points.

According to Combs (1952) intelligence is related to the number of discriminations one makes in his perceptual field. Kephart (1960), moreover, proposed a theory of classroom learning which rests heavily upon the adequacy of a child's perceptual-motor skills.

Several years ago the writer raised the question could a child learn more if he is given exercises which promote acquisition and refinement of perceptual-motor skills. He, therefore, developed a perceptual training procedure which involves giving students corrective feedback, after the completion of predetermined units of work, for veridical identification of symbols, left to right orientation, correct organization of a time sequence, and induction of a response in the absence of a visible cue. Using this procedure, underachieving children of average intelligence were observed to improve in achievement (Chansky, 1963). Giving one group of young mental retardates perceptual training in individual sessions and another group perceptual training in a simulated classroom situation, Chansky and Taylor (1964) not only found that the trained groups improved on intelligence and on achievement tests more than a control group but also the differences between the two trained groups were not significant for several variables. In addition, it was inferred from performance curves, that the trained children acquired discrimination, orientation, organization and induction skills.

The studies thus far have yielded suggestive evidence that students receiving perceptual training do improve academically. There have been several limiting aspects to these explorations, however. Highly selective groups have been trained, usually slow learners. The training has been such as to introduce a novelty into the school day. Children have either been taken out of class or the classroom routine had been interrupted in order to train the children. Training materials have been three dimensional but relationships have been sought with activities like reading which take place in two dimensional space. No followup was undertaken to determine if improvement could be sustained. The effect of motivation, moreover, cannot be discounted. After study in the differential effects of set and tachistoscopic training, Marvel (1959) concluded that reading ability could be improved by increasing the motivation of the pupil. Training perception tachistoscopically was of secondary importance in producing change. Walter and Kosowski (1962)

concluded that when retarded readers have an incentive they become more attentive and learn to read better. Separating student incentive experimentally from the training he is exposed to is quite difficult. Yet some effort must be made to study their individual effects.

To develop greater understanding between perceptual-motor behavior and such variables as gains in school achievement and in intelligence, several questions were raised. What the effect is of perceptual training of children heterogeneous with respect to intelligence and to achievement upon gains on these variables was first. Next, is training with material in two dimensional space as effective as training with materials in three dimensional space. Finally, to control the effects of the novelty of training a question concerning the sustaining of gains during periods of no training was raised.

Sample

Students were enrolled in the third grade of the Durham County Public School System. The total number of students tested was 178. The sample was drawn from eight different classrooms. Because analyses of variance of the initial intelligence and total achievement scores revealed differences due to race and to sex, the participants were matched on sex, race, intelligence, and achievement. What resulted from the matching was four equivalent groups of seven Negro boys and seven Negro girls each and of eight Caucasian boys and eight Caucasian groups each.

Training Materials

For three dimensional training, Halsam Products Company Blockville Set Number 102 was used. This set contains two main block shapes: triangles and rectangles. The rectangles have four patterns impressed upon them: tree branches, school windows, church windows and jail windows. Stimulus designs accompanying

the set were presented and the children were to reproduce the designs by matching the impression on the blocks with the components on the model. Children were to proceed from left to right, to erect one story at a time and to place blocks in positions not revealed by the design itself but nonetheless necessary for correct reproduction of the design. Corrective feedback was for figure matching, orientation, organization and inference building.

For two dimensional nonverbal materials, the designs accompanying the Blockville Set were cut in one inch squares. The stimulus designs presented were identical to those in three dimensional training. Here, however, the children had to match the one inch squares with the designs in the picture. Students were urged to proceed from left to right and to complete the first row before moving up to the second. Corrective feedback was for figure matching, orientation and organization.

The McCall Crabbs Test Exercises in Reading served as the two dimensional verbal materials. The children read the test exercises and the experimenter revealed the answers. Discussion of the answers ensued, permitting the student not only to learn what answer was correct but why it was correct.

Procedure

In September, the California Test of Mental Maturity, the Raven's Progressive Matrices Test, and the California Achievement Tests were administered to the eight classes participating in this study. After the battery was administered three classes in predominantly Caucasian schools were selected at random to receive, 1. the blocks, 2. the puzzles and, 3. the reading training. For the eleven weeks following the experimenters administered the training and the feedback appropriate to each experimental method. The presence of three experimenters permitted a 9 - 1 experimenter - pupil ratio. Training sessions were no longer than 20 minutes each to prevent interference with other classroom activities. At the end of each

training session, each class was administered one exercise in the McCall Crabbs Test Exercises in Reading. The answers were never discussed. During the first experimental period, the remaining five classes served as controls. Each week the experimenters visited these classes and administered one exercise in the McCall Crabbs Test Exercises in Reading. The answers were not discussed in these classes either.

In January the battery of tests was readministered. After which, students in the predominantly Negro Schools were selected to receive the blocks, puzzles, and reading training. After each session these groups received one exercise in the McCall Crabbs Test Exercises in Reading. No feedback was given and the exercises were not scored by the students. To the remaining five classes, the same exercise was also administered without feedback. In May, the battery of tests was administered once again. The procedure is summarized in Figure 1 below:

Figure 1

Summary of Experimental Procedure

	First eleven weeks				Second eleven weeks			
C - 1	T	Blocks	FMUR	T	-	FMUR	T
C - 2	T	Puzzles	FMUR	T	-	FMUR	T
C - 3	T	Corrected Reading	FMUR	T	-	FMUR	T
C - 4	T	-	FMUR	T	-	FMUR	T
N - 1	T	-	FMUR	T	Blocks	FMUR	T
N - 2	T	-	FMUR	T	Puzzles	FMUR	T
N - 3	T	-	FMUR	T	Corrected Reading	FMUR	T
N - 4	T	-	FMUR	T	-	FMUR	T

T - Test battery

FMUR - Five minute uncorrected reading

C - Caucasian

N - Negro

Results

The difficulty of the designs was determined by administering the 15 designs in counterbalanced order to 104 third graders in Walkill, N. Y. No two students worked on the same sequence of designs. No two neighbors were working on the same design at the same time. At no time was feedback of any kind given. The orientation, organization, alignment, discrimination and time errors were tallied. Total time for completing the designs was determined, too. The 15 designs were then arranged in ascending order of difficulty. The designs were presented to the blocks and puzzles group according to the order of ascending difficulty.

Before testing the gains hypotheses analyses of variance of the pretest I. Q. and achievement were run. These revealed significant differences between the sexes and between the races. It was, therefore, decided to reduce the degrees of freedom for error by examining the variation due to sex and to race. Ordinarily, gains could be examined by subtracting the first score from the second. Recently, though, several papers cautioned the use of this technique. It undoubtedly gives a fair estimate of differences when the test retest reliability coefficients are high.

Table 1

Intercorrelations Between Pre and Post Tests

	Caucasian boys (32)	Caucasian girls (32)	Negro boys (28)	Negro girls (28)
Language I. Q.				
B_2, B_1	.64	.78	.81	.52
B_3, B_2	.81	.84	.90	.67
Non Language I. Q.				
B_2, B_1	.75	.75	.69	.30
B_3, B_2	.79	.77	.84*	.56

Intercorrelations Between Pre and Post Tests (continued)

Total I. Q.				
B_2, B_1	.81	.84	.77	.54
B_3, B_2	.86	.88	.91	.65
Logical Reasoning				
B_2, B_1	.82	.71	.69	.49
B_3, B_2	.82	.73	.78	.60
Numerical Reasoning				
B_2, B_1	.61	.69	.55	.21
B_3, B_2	.67	.68	.82*	.38
Verbal Concepts				
B_2, B_1	.63	.58	.64	.18
B_3, B_2	.51	.63	.67	.19
Memory				
B_2, B_1	.52	.58	.65	.43
B_3, B_2	.76*	.82*	.68	.59
Reading Vocabulary				
B_2, B_1	.72	.78	.71	.74
B_3, B_2	.78	.67	.81	.57
Reading Comprehension				
B_2, B_1	.72	.61	.75	.61
B_3, B_2	.76	.74	.72	.74
Arithmetic Reasoning				
B_2, B_1	.71	.65	.81	.42
B_3, B_2	.81	.76	.95	.82*

Intercorrelations Between Pre and Post Tests (continued)

Arithmetic Fundamentals				
B_2, B_1	.67	.37	.57	.62
B_3, B_2	.74	.56	.79	.75
Mechanics of English				
B_2, B_1	.41	.27	.61	.53
B_3, B_2	.79*	.66*	.81*	.41
Spelling				
B_2, B_1	.81	.58	.56	.68
B_3, B_2	.86	.75	.88*	.60
Total Battery				
B_2, B_1	.75	.73	.81	.77
B_3, B_2	.90	.88	.93	.86
Raven				
B_2, B_1	.62	.64	.64	.59
B_3, B_2	.83	.82	.80*	.60

*Correlation of B_1, B_2 different from that of B_3, B_2 at the 5 per cent level

B_1 - Battery before training

B_2 - Battery after training

B_3 - Battery after no training

The next step, then, was to compute the pre and post training test scores as well as the post training - no training scores. These data are found in Table 1. For many of the test scores studied the reliability coefficients over the three month intervals are quite low. Out of 30 intercorrelations, nine were above .8 for Caucasian boys (CB); six, for Caucasian girls (CG); 13 for Negro boys (NB); and two for Negro girls (NG). These data suggested that the scores were quite

unstable and hence if uncorrected would influence the standard error of the mean. Also, of particular interest to this study was the fact that test - training - retest coefficients were significantly lower than test - no training - retest coefficients. Training, then, made the groups more variable.

To correct for the relatively low reliability coefficients, change was calculated by a Formula proposed by Lacey.* The Formula was:

$$50 + 10\left[\frac{(Y - X)(r_{XY})}{\sqrt{1 - r^2_{XY}}}\right]$$

where 50 is an arbitrary mean; 10 an arbitrary standard deviation, Y is the second score transformed into Z scores, X is the first score transformed into Z scores, and r_{XY} is the correlation between the second and the first test. Because there were differences between races and sexes the change scores were computed separately for Caucasian boys, Caucasian girls, Negro boys and Negro girls. This transformation not only controls the unreliability in the raw scores but also simplifies interpretation of the findings. Hence a change score of 50 indicates no change from pre to post test; one lower than 50, a loss; one above 50, a gain. All scores to be reported are transformed scores with a mean of 50 and a standard deviation of 10.

The first null hypothesis to be tested was trained groups gain no more in intelligence than untrained groups. Analyses of variance were run on the gain scores. These are presented in Table 2. Treatment and the interaction between sex, race, and treatment are significant. Differences between these means were tested by Duncan Bonnar's test (1954). These results appear at the bottom of Table 2.

*Lacey, J. I. The Evaluation of Autonomic Responses: Toward a General Solution. Antioch College, Yellow Springs, Ohio. Unpublished.

Table 2

Anova of Gains in Language I. Q.

Source of Variation	df	Mean Square	F
Sex	1	0	0
Race	1	0	0
Treatment	3	220.38	4.58**
S x T	3	71.09	1.46
R x T	3	54.88	1.12
S x R x T	3	141.80	2.89*
Within	105	48.93	

**Significant at one per cent level with 3/105 df

*Significant at 5 per cent level with 3/105 df

Means

		(NB)	(NG)	(CB)	(CG)
Blocks (B)	50.60	54.12	48.73	48.14	51.66
Puzzles (P)	46.67	48.67	47.36	48.25	42.66
Reading (R)	53.43	46.85	56.09	55.48	54.69
Control (C)	49.30	50.32	47.79	48.09	50.95

Significant Differences

Reading - Puzzles	NGR - CGP	CBR - CGP	CBR - CBP	CGC - CGP
	NGR - NBR	CBR - NBR	CGR - CGP	NBC - CGP
Reading - Control	NGR - NGP	CBR - NGC	CGR - NBR	NGR - CBB
	NGR - NGC	CBR - CBC	CGR - NGP	NGR - CBP
Blocks - Puzzles	NGR - CBC	CBR - CBB	NBB - CGP	NGR - NBP
	NBB - NBR	NGR - NGB	CGB - CGP	

Changes in Language I. Q. differed as a function of the experimental treatments. The Reading group differed from the Puzzle group. The comparison between the means suggest that the Reading group gained while the Puzzle group lost I. Q. points. The Reading group gained more than the Control group. While there were no differences between the Reading group and the Blocks group or the Blocks and the Control group, the group receiving the blocks treatment did differ significantly in Language I. Q. change from the group receiving the puzzles.

The interactions between race, sex and treatment suggest that gains in I. Q. were influenced by these three sources of variation. Duncan's test was run on the differences between the means. They revealed that the Negro girls receiving the reading treatment differed in mean gain from the Caucasian girls receiving puzzles, the Caucasian boys control, Negro girls receiving puzzles, Negro control girls, Negro girls receiving puzzles, Negro boys receiving reading, Negro boys receiving puzzles, Caucasian boys receiving puzzles, and Caucasian boys receiving blocks. Caucasian boys receiving reading differed from Caucasian girls receiving puzzles, Negro boys receiving reading, Caucasian control boys, Caucasian boys receiving blocks or puzzles, and Negro control girls. Caucasian girls receiving reading differed from those receiving puzzles, Negro boys receiving reading and Negro girls receiving puzzles. Caucasian girls receiving puzzles differed from the Caucasian girl control group. The Negro boys receiving blocks differed from the control girls receiving puzzles and the Negro boys receiving reading. The Negro boy control group differed from the Caucasian girls receiving puzzles.

Certain observations concerning gains in Language I. Q. emerge. Negro girls, Caucasian boys and Caucasian girls increase when exposed to reading; Negro boys increase when exposed to blocks, and all groups decline when exposed to puzzles, more especially the Caucasian girls.

Non Language I. Q.

In Table 3 is the analysis of variance of the gains in non language I. Q. On the bottom of the Table are the results of the Duncan - Bonnar tests of the

Table 3

Anova of Gains in Non Language I. Q.

Source of Variation	df	Mean Square	F
Race	1	0	0
Sex	1	0	0
Treatment	3	214.68	3.83*
S x T	3	136.14	2.43
R x T	3	147.76	2.62
R x S x T	3	9.12	0.16
Within	105	56	

*Significant at the 5 per cent level of probability

Treatment	Means	Significant Differences
Blocks	54.10	B - P
Puzzles	49.00	B - R
Reading	47.83	B - C
Control	49.10	

differences between the means. The treatment was a significant effect. Those students who received the Blocks treatment gained in non language I. Q. more than any other group. The mean scores, moreover, indicate that students receiving the other treatments lost I. Q. points.

Total I. Q.

An analysis of variance of the gains in total I. Q. revealed no differences between groups or treatments. These results are presented. The interaction

Table 4

Anova of Gains in Total I. Q.s

Source of Variation	df	Mean Square	F
Sex	1	0	0
Race	1	0	0
Treatment	3	80.1	1.28
S x T	3	6.2	0.10
R x T	3	56.7	0.91
R x S x T	3	145.2	2.32
Within	105	66.6	2.32

approaches significance but the F ratio is too low to be considered anything but due to chance. In the event that Type II error is being committed here, the means showed the following groups to have gained: Negro Boys Control (M = 52.77), Negro Girls Reading (M = 53.81), Caucasian Boys Reading (55.37), Caucasian Girls Blocks (51.62), Reading (52.18), and Control (51.60). Losses were observed in all other groups the most sizable being in the Caucasian Girls Puzzle Group (M = 44.56).

Raven Progressive Matrices

The Raven's Progressive Matrices (RPM) Test bears a striking resemblance to the abilities which the present experiment endeavored to alter. Yet the analysis of variance of RPM change scores revealed no significant change as a function of treatment, sex, or race. Upon further inquiry Puzzle and Reading treatments, it is suggested here, may reveal some relevant data concerning their effects on I. Q. change. The mean score for the Caucasian girls receiving puzzles was 53.04; for Negro girls, 50.82; for Caucasian boys, 50.21; and for Negro boys, 49.43. The mean score for Caucasian boys receiving reading was 54.54; for Negro boys, 50.72; for Caucasian girls, 50.36; and for Negro girls, 50.43. The groups receiving the

Table 5

Anova of Gains in Raven's Progressive Matrices

Source of Variation	df	Mean Square	F
Sex	1	0	0
Race	1	0	0
Treatment	3	64	1.33
S x R	3	31	0.65
S x T	3	69	1.43
S x R x T	3	5	0.11
Within	105	48	

blocks showed losses. The boys from the Control group showed losses (47.11 (N) and 46.26 (C)), whereas, the girls showed gains (51.97 (N) and 50.46 (C)).

In summary, scores on the California Test of Mental Maturity were observed to change singificantly as a function of treatment, sex and race. The greatest change in Language I. Q. was for the group receiving the reading. The group receiving the blocks did gain more than the group receiving the puzzles, primarily because the latter group consistently registered losses. Gains in non language I. Q. were consistently higher for the groups receiving the blocks. Changes in the total I. Q. and Raven's Progressive Matrices could be attributed to chance. Next the null hypothesis that there are no differences in the gains in achievement of the several groups was tested. Vocabulary gains were first to be studied. In the analysis of variance in Table 6 only the race by treatment interaction was significant. The Duncan Bonnar Test was applied to race by treatment data. Caucasians given the blocks treatment gained significantly more than Caucasians given the puzzles or Negroes given the blocks. Negroes receiving the reading treatment gained more than Caucasians given the puzzles. Reading vocabulary gains

Table 6

Anova of Gains in Vocabulary Achievement

Source of variation	df	Mean Square	F
Race	1	0	0
Sex	1	0	0
Treatment	3	135	2.41
S x T	3	27	0.46
R x T	3	283	5.05*
R x S x T	3	13	0.23
Within	105	56	

*Significant at the one per cent level

Means		Significant Differences
CB	54.17	CB - CP
NR	53.58	CB - NB
NP	50.71	NR - CP
CR	50.56	
CC	48.44	
NC	48.06	
NB	47.70	
CP	46.84	

were related to the blocks treatment among Caucasians but reading treatment among Negroes. Greatest losses were among the Caucasians receiving the puzzle treatment.

Gains in reading comprehension were also related to the interaction between race and treatment. In Table 7 the analysis of variance reveals no treatment, sex by treatment, or triple classification interaction effects.

Table 7

Anova of Gains in Reading Comprehension

Source of Variation	df	Mean Square	F
Sex	1	0	0
Race	1	0	0
Treatment	3	92	1.80
R x T	3	165	3.23*
S x T	3	97	1.90
R x S x T	3	12	0.23
Within	105	51	

*Significant at the 5 per cent level

Means		Significant Differences
Caucasian		
CR	54.00	CR - CP
NP	52.21	CR - NC
CC	50.68	NP - CP
NB	50.60	
CB	50.06	
NR	49.21	
NC	47.93	
CP	45.73	

The means of the race by treatment interaction were tested for significance with the Duncan Bonnar Test. The gains of the Caucasian group were significantly greater than those of the Caucasian puzzle group or the Negro Control group. The Negro Puzzle group, however, gained significantly more than the Caucasian Puzzle group.

Table 8

Anova of Gains in Arithmetic Fundamentals

Source of Variation	df	Mean Square	F
Race	1	0	0
Sex	1	0	0
Treatment	3	113	2.17
R x T	3	2	.00
S x T	3	88	1.69
R x S x T	3	30	0.57
Within	105	5488	

Examined next were the gains in arithmetic fundamentals. Table 8 reveals no significant effects of treatment, race by treatment, sex by treatment, or race by sex by treatment.

An examination of Table 9 reveals, however, that gains in arithmetic reasoning were unaffected by treatment. The nearly significant treatment effect was undoubtedly due to the losses of the puzzle group rather than gains in the other three groups.

Table 9

Anova of Gains in Arithmetic Reasoning

Source of Variation	df	Mean Square	F
Sex	1	0	0
Race	1	0	0
Treatment	3	116	2.37
S x T	3	38	0.78
R x T	3	70	0.14
S x R x T	3	74	0.18
Within	105	49	

Table 10

Anove of Gains in Mechanics of English

Source of Variation	df	Mean Square	F
Sex	1	0	0
Race	1	0	0
Treatment	3	148	4.93**
S x T	3	48	1.60
R x T	3	12	0.40
S x R x T	3	83	2.76*
Within	105	30	

**Significant at the one per cent level

*Significant at 5 per cent level

	Means
Blocks	49.36
Puzzles	47.03
Reading	51.17
Control	52.07

Significant Differences

R - P

C - P

	NB	NG	CB	CG
Blocks	52.00	48.78	47.66	49.38
Puzzles	42.40	40.60	48.17	46.80
Reading	50.61	51.41	51.69	51.89
Control	54.77	49.19	52.47	51.92

NBC - NBP	CBC - NBP
NBC - CGP	NBB - NBP
NBC - CBB	CGC - NBP
NBC - CBP	CGR - NBP
NBC - NGP	CBR - NBP
NGR - NBP	NBR - NBP
NGP - NBP	CGB - NBP
NGC - NBP	

Examined next were gains in the mechanics of English achievement. Table 10 reveals that the only significant source of variation was treatment. The group receiving the puzzles gained significantly less than either Reading or Control groups. The interaction between sex, race and treatment indicated that most sub-groups gained more than the Negro boys receiving the puzzles. The Negro boy Control group made the greatest gains in mechanics of English. The Caucasian boy Control group also made greater gains than the other groups. It is the writer's opinion, however, that the differences be attributed to the loss in scores of the Negro boy Puzzle group.

Table 11

Anova of Gains in Spelling

Source of Variation	df	Mean Square	F
Sex	1	0	0
Race	1	0	0
Treatment	3	291	3.16*
R x T	3	22	0.24
S x T	3	178	1.82
R x S x T	3	82	0.93
Within	105	92	

*Significant at the 5 per cent level

	Means	Significant Differences
Blocks	46.13	R - B
Puzzles	48.80	
Reading	53.70	
Control	49.63	

The last score to be examined was spelling. Table 11 contains the analysis of variance of spelling gains. Only treatment was significant. The Duncan Bonnar

Test was appoied to the means. The reading treatment was observed to yield greater gains in spelling than the block treatment.

In summary, the reading treatment contributed to gains in achievement, more especially in reading comprehension, arithmetic fundamentals, mechanics of English and spelling. The blocks made their contribution to improvement in vocabulary. Most important to note, however, was that certain treatments were linked to achievement when race and sex were considered. Races and sexes responded differently to the same treatment. While the blocks were responded to with greater gains among the Caucasions, Negroes responded more favorably to the puzzles. This was not always the case. Negro boys receiving puzzles lost points in mechanics of English. These data do not permit an all or none statement about the effects of treatment, race, and sex on achievement because the results differed for the several achievement variables.

Standardized tests, like the California Achievement Tests, may at best be administered three times each year. Therefore, they permit the assessment of improvement but twice. Since the training was designed to study the question of improvement, some valid method of making this assessment was sought. The McCall Crabbs Standard Test Lessons in Reading (1961) contains short reading exercises followed by several questions. The number of correct answers may be converted into grade equivalents. To assess the effects of training, the test lessons in Reading were given to each group each week. The median performance for the second month was compared with the median performance for the first month. Also compared was the median performance of the last month with the median performance for the first month. Again the formula for gains used in studying the other measures was employed here, too. All observations are T scores corrected for the test retest reliability of the measures.

Table 12

Anova of Gains in Weekly Reading Exercises

		First Quarter		Last Quarter	
Source of Variation	df	M. S.	F	M. S.	F
Sex	1	0	0	0	0
Race	1	0	0	0	0
Treatment	3	108	2.5	6	0.1
S x T	3	39	0.9	74	1.6
R x T	3	136	3.2*	127	2.8*
S x R X T	3	27	0.6	11	0.2
Within	105	42		45	

*Significant at 5 per cent level

	Means	
NB	52.9	53.4
NP	47.6	47.7
NR	52.4	49.9
NC	47.0	49.0
CB	48.8	48.0
CP	52.9	52.0
CR	49.0	50.1
CC	49.2	49.8

	Significant Differences	
NB - NC	CP - NC	NB - NP
NB - NP	CP - NP	NB - WB
NB - CB	CP - CB	NB - NC
NB - CR	CP - CR	CP - NP
NR - NC	CP - NC	CP - WB
NR - NP		

Table 12 contains the analyses of variance of the gains scores at the beginning of training and at the end of training. Only the variation due to the interaction between race and treatment were significant. Applying the Duncan Bonnar Test to the means, it was observed that Negroes receiving the block treatment gained more during the first quarter of training than the Negro Control group, the Negro Puzzle group, the Caucasian Block Group and the Caucasian Reading group. The Negro Reading group, moreover, gained more than the Negro Control and the Negro Puzzle groups. The Caucasian Puzzle group gained more than the Negro Control, the Negro Puzzle, the Caucasian Block, the Caucasian Reading and the Negro Control groups. Frequently the novelty of a treatment results in temporary gains by some and losses in others due to the struggle to adjust to the novelty. The significant differences in the last quarter of training reveal that the Negro Block and the Caucasian Puzzle groups maintain their gains. Specifically, the Negro Block group gained more than the Negro Puzzle, the Negro Control, and the Caucasian Block groups and the Caucasian Puzzle group gained more than the Negro Puzzle and the Caucasian Block groups.

Analyses of variance of the reading scores during the equivalent no training periods revealed no differences between the groups. Perusal of Table 13 suggests the hypothesis that training or some attendant phenomenon yields greater gains than during no training. Attention is focused on the Negro Block group whose scores under treatment tended to be higher than under no treatment and to the Negro Puzzle group whose scores tended to be higher during no treatment. Also to be noted is the superiority of the Caucasian Puzzle group during treatment in contrast to no treatment. That the blocks facilitated reading improvement in the Negro group and the puzzles in the Caucasian group is especially noteworthy since these results do not agree with the results obtained with the California Achievement Test. To explain this discrepancy, the writer forwards this hypothesis. The

Table 13

Mean Gain Scores During Treatment and No Treatment Periods

	Treatment		No Treatment	
Group	First Quarter	Last Quarter	First Quarter	Last Quarter
NB	52.9	53.4	50.0	50.1
NP	47.6	47.7	49.5	50.2
NR	52.4	49.9	52.0	50.8
NC	47.0	49.0	48.5	48.1
CB	48.8	48.0	48.9	49.7
CP	52.9	52.0	48.5	49.3
CR	49.0	50.1	52.5	49.9
CC	49.2	49.8	50.1	51.2

McCall Crabbs Standard Test Lessons in Reading was not perceived by the pupils as tests. Hence, they could relax. The conditions were more informal, moreover, than when the standardized tests were given. The puzzles appeared to have a decremental effect on achievement because they were associated with intense frustration. Rarely did the students complete the puzzles in the time allotted them. It was certainly not unknown to the Puzzle group that they were participating in an experiment and that other classes were receiving different treatments. Performance on the standardized achievement test was lowered because of the connections that the children had with the experimenters administering the treatment. The treatment, though, inducing anxiety permitted the McCall Crabbs, an unscored "exercise" to be an effective outlet. At least they could prove to themselves that there was something they could do. During the no treatment period the frustration was lacking and the performance on the McCall Crabbs decreased. At the same time, though, examination of the gains scores on the California Achievement Test increased. No longer were the Caucasian Puzzle group under the duress of having to prove

themselves. The question of gains during treatment and no treatment period will be discussed now.

Table 14

Gains in Language I. Q. During Treatment and No Treatment

Group	Treatment Gain	No Treatment Gain	t ratio
NBB	52.06	50.13	-
NBP	42.54	53.30	-4.74**
NBR	50.60	48.24	-
NBC	54.76	48.29	-2.85*
NGB	48.78	48.53	-
NGP	50.60	47.98	-
NGR	51.40	49.79	-
NGC	49.19	53.66	+3.04**
CBB	47.65	53.39	+3.90**
CBP	48.16	48.52	-
CBR	50.60	52.27	-
CBC	52.47	45.78	-3.93**
CGB	49.37	50.35	-
CGP	46.80	53.23	+4.56**
CGR	51.88	47.76	-2.92*
CGC	51.92	48.62	-

*Significant at 5 per cent level with N - 1 df

**Significant at one per cent level with N - 1 df

The last null hypothesis to be tested was that changes during periods of no training are no greater than changes during periods of training. Several scores were observed to have changed significantly during periods of treatment. What will be examined here is the question of whether these gains are different under periods

of no treatment. To be examined first are changes in Language I. Q. In Table 14 are the gains during treatment and without treatment. The groups which changed most during the year were the Control groups. These groups received no experimental treatment at all. There was no direction to the change. Some Control groups gained during the "no treatment period" others lost. Attention should be directed to the Negro boy Puzzle group and the Caucasian girl Puzzle group. For the Negro boys, treatment followed a period of no treatment. It is quite clear that during treatment they experienced losses in Language I. Q. Treatment preceded no treatment among the Caucasian girls. After treatment they made gains in Language I. Q. Also the Caucasian girls receiving the reading treatment experienced losses during the no treatment period. With respect to gains in I. Q., for most groups the size of the gain was no different under treatment or no treatment. Those children receiving puzzles tended to experience losses which were not noted during the no treatment periods.

The groups receiving the blocks gained in non language I. Q. In Table 15 there are the gains of each group during periods of no treatment. The interaction between sex, race, and treatment is worthy of note. While Negro Puzzle boys lost during the experimental period in contrast to the control period, Negro Puzzle girls gained. Gains were also greater for the Negro boys receiving the reading treatment in contrast to the no treatment period. Of considerable interest, however, is the observation that the Caucasians who received the blocks treatment had made gains during the experimental period but continued to gain during the period of no treatment. No direct comparison with the Negro Block groups is possible because they received the "no treatment" procedure first.

I. Q. gains remained stable for most groups. Certain groups receiving the puzzles tended to experience losses during the treatment whereas groups receiving the blocks tended to continue to gain in I. Q.

Table 15

Gains in Non Language I. Q. During Treatment and No Treatment

Group	No Treatment - Means - Treatment		t ratio
NBB	53.30	48.37	-
NBP	53.10	47.68	+2.48*
NBR	42.27	49.95	-3.52*
NBC	51.29	53.25	-
NGB	50.70	48.48	-
NGP	48.21	52.75	-3.28*
NGR	49.37	50.32	-
NGC	51.68	48.41	-
CBB	56.56	51.08	+2.67*
CBP	49.68	48.70	-
CBR	47.60	50.93	-
CBC	46.11	49.24	-
CGB	55.28	50.51	_2.36*
CGPCGP	45.38	49.63	-
CGR	51.43	50.32	-
CGC	47.87	49.50	-

*Significant at the 5 per cent level with N - 1 df.

Examined next was the stability of gains in vocabulary. Caucasians receiving the blocks made the greatest gains in vocabulary. An examination of Table 16 reveals that these gains were not sustained nor were the gains of the Negro girl reading and control groups. The Negro girls receiving the block treatment made greater gains during the no treatment period.

Gains in reading comprehension had been observed in the Caucasian reading groups primarily. In Table 17 are data which reveal that in the absence of the

Table 16

Gains in Vocabulary During Treatment and No Treatment

Group	No Treatment Means	Treatment Means	t ratio
NBB	49.67	51.50	-
NBP	51.92	50.61	-
NBR	51.57	52.53	-
NBC	46.81	45.32	-
NGB	54.61	43.70	+5.19**
NGP	52.46	50.82	-
NGR	49.18	54.63	-2.59*
NGC	43.72	50.80	-3.37*
CBB	46.70	52.96	-3.08*
CBP	50.11	47.37	-
CBR	51.79	52.64	-
CBC	51.27	46.99	-
CGB	49.84	55.39	-2.84*
CGP	49.57	46.31	-
CGR	49.79	48.36	-
CGC	50.76	49.89	-

*Significant at the 5 per cent level with N - 1 df

**Significant at the one per cent level with N - 1 df

experimental treatments, gains are not stable, especially for girls. The girls who had received the blocks and the puzzles had gained more during no treatment than during treatment. The girls in the reading treatment group as well as in the control had made greater gains during the treatment period. The effect, then, of the reading treatment on reading comprehension is temporary. It appears also that whatever decremental effect puzzle training has on reading achievement is

Table 17

Gains in Reading Comprehension During Treatment and No Treatment

	No Treatment Means	Treatment Means	t ratio
CBB	50.53	49.97	-
CBP	48.32	45.81	-
CBR	52.61	54.01	-
CBC	48.50	50.18	-
CGB	54.86	50.16	2.55*
CGP	51.08	44.70	3.46*
CGR	48.08	53.96	-3.19*
CGC	45.95	51.15	-2.82*

*Significant at the 5 percent level with N - 1 df

removed during the period of no training.

The greatest gains in mechanics of English had been for the reading treatment groups. Inspection of Table 18 reveals that these gains were not always sustained. Where there were losses during the treatment period for the Caucasian girl Puzzle group they were erased during the no treatment period. A noticeable change in mechanics of English expression for the Negro boy Puzzle and the Caucasian girl Puzzle group. Both gained more when not subjected to the puzzle treatment. Negro girls, on the other hand, gained more during treatment. Improvement was noted in the Negro boy and Caucasian girl reading groups during treatment. Without treatment these groups did not gain. Significant changes were noted in the Control groups but in no consistent direction. It appears that the puzzle training has a decremental effect on achievement in mechanics of English. It is erased when the treatment is removed. The reading treatment, on the other hand, has an incremental effect on achievement, but it is removed when the treatment ceases.

Table 18

Gains in Mechanics of English During Treatment and No Treatment

Group	No Treatment Means	Treatment Means	t ratio
NBB	50.28	48.78	-
NBP	53.28	42.40	-10.88**
NBR	48.43	50.61	- 2.74*
NBC	48.45	54.77	- 7.97**
NGB	48.47	48.78	-
NGP	48.41	50.60	- 2.76*
NGR	49.85	51.41	-
NGC	53.56	49.19	+ 5.51**
CBB	53.62	47.66	+ 7.52**
CBP	48.62	48.17	-
CBR	52.37	51.69	-
CBC	45.75	52.47	- 8.47**
CGB	50.50	49.38	-
CGP	53.25	46.80	+ 8.13**
CGR	47.50	51.89	-5.54**
CGC	48.75	51.92	- 3.99**

*Significant at 5 per cent level with N - 1 df

**Singificant at one per cent level with N - 1 df

Finally to be considered are the spelling gains. The group receiving the reading had made the greatest gains in spelling. Table 19 reveals that groups were not at all stable with respect to gains in spelling achievement. Gains were larger during the no treatment period for the Negro girl puzzle, Caucasian girl reading, Caucasian boy blocks, Negro boy blocks, Caucasian boy puzzle, and the Negro boy block groups but greater during training, for the Negro girl reading,

Table 19

Gains in Spelling During Treatment and No Treatment

Group	No Treatment Means	Treatment Means	t ratio
NGP	55.85	46.60	+8.78**
CGR	54.00	50.42	+3.39**
NBP	52.71	50.31	-
NGB	52.13	49.11	-
CBB	52.12	43.69	+8.01**
NBC	52.00	49.38	+2.49*
CBP	51.50	47.92	+3.40**
NBB	50.14	40.63	+9.03**
NGC	49.57	48.14	-
NGR	49.00	54.24	-4.98**
CGC	48.87	50.07	-
CBC	48.63	50.59	-
CBR	47.50	57.77	-9.75**
NGB	45.71	50.98	-5.00**
NBR	45.24	52.25	-6.61**
CGP	45.13	50.35	-4.96**

**Significant at one per cent level with N - 1 df

*Significant at 5 per cent level with N - 1 df

Caucasian boy reading, Negro girl blocks, Negro boy reading, and Caucasian girl puzzle groups. These data emphasize once again that the gains in the reading treatment group are a function of the treatment and these gains are not maintained, e.g. CBR. The decremental effects of the puzzles on most groups was observed once again. Correspondingly, however, the losses vanish in the no treatment period. Clearly gains and losses, though linked with treatment, are not sustained during period of no treatment.

Conclusions and Implications

Up to the present time the use of blocks in perceptual training of organization, discrimination and spatial orientation have been restricted to atypical groups. Not only that but in the first study which Chansky reported (1963), the children were receiving reading instruction from several remedial teachers, no two of whom had the same approach to reading. In this study as well as in a second study with retarded readers (1964), gains were designated by the crude difference in raw scores on intelligence and on achievement. In the present study the test retest reliability among the scores are considered in assessing gain.

The present study may be viewed as a refinement in methodology. Groups were matched according to sex, race, initial intelligence, and initial achievement. the several treatments employed, blocks, puzzles, and reading were controlled by the experimenters. To this extent the present study has fewer limitations than the previous ones. Despite the refinements, it must be borne in mind that each experimental treatment involved but one half hour each week for eleven weeks. Other activities take place which would influence the dependent variables: gains in intelligence and gains in achievement. To assume that the daily activities of any class has a random effect on gain scores must first be proven. Since these effects are at present not known, the findings to be discussed may be viewed as limited and founded on the unproven assumption of randomization of other effects on the class.

The treatments did not always have a unitary effect. It was observed rather that the gains produced in the several variables resulted from an interaction between treatment, race, and sex. In general, the most sizable gains made during training were in groups receiving the reading or the block treatments. With respect to changes in Language I. Q., Negro girls and Caucasian boys receiving reading improved as did Negro boys receiving the blocks. With regard to changes

in non language I. Q. it was the group receiving the blocks making the greatest changes. Noted here, moreover, was the group receiving puzzles lost I. Q. points. These tendencies for the blocks and reading to produce increments in I. Q. and for the puzzles to produce decrements was observed rather consistently in gains in achievement. The effect was not general for all subgroups receiving the treatment but was for certain ones. The Caucasians receiving blocks and Negroes receiving reading gained more in vocabulary than the Caucasians receiving the puzzles. The Caucasians receiving reading and the Negroes receiving the puzzles gained more in comprehension than the Caucasians receiving the puzzles. Gains in spelling and in mechanics of English were influenced by the reading treatment. In each instance the group receiving the puzzles, more especially the Caucasians tended to decrease in performance relative to the group.

Weekly exercises in the McCall Crabbs Test Lessons in Reading were administered. Performance on these exercises in the first and last quarter of training were examined. Negroes receiving blocks, Negroes receiving reading and Caucasians receiving puzzles made consistently greater gains than other groups during the treatment period. At first the increments of the Caucasian puzzle group may appear inconsistent with other observations. The findings will be reconciled.

Examination of gains on standardized intelligence and achievement tests during treatment and no treatment periods revealed that gains of the reading and blocks groups appeared during the treatment period. Negroes received the no treatment period first. Their greatest gains followed. Caucasians received the treatment period first. During the no treatment period the gains were less conspicuous. Only the Caucasians who received the block treatment continued to gain in non language I. Q. The groups receiving the puzzles almost always gained more during periods of no treatment.

The purpose of the study was to teach children to organize their perceptions more adaptively. Three types of materials were used: three dimensional configurations, two dimensional configurations, and reading, another two dimensional perceptual activity. The students receiving the puzzles, the two dimensional configuration materals, had great difficulty with them. Rarely could they finish them in time. Negro girls primarily, learned the task faster than the other groups. It appears that rather than teaching organization, the task was frustrating and hence a disrupter of organized perception. This was not so with reading and blocks. The tasks were such as to permit success and allow perceptual closure. To interpret the present results, the writer theorizes that perceptual training does make students more attentive to cues, to orientation, and to the structuring of ideas. It is this "honing" of the sensory behavior of children which is linked with gains in intelligence and in achievement. The study also demonstrated that in periods of no training the increments in the reading and clock groups and the decrements in the puzzle group disappear. It is not that the former experience losses. Rather it is they make no further gains relative to the other groups. The puzzle group, on the other hand, no longer under the duress of training make gains. These gains may be likened to the gains they had always made on the McCall Crabbs, a nonstressful situation viewed as an exercise and not as a test or an experimental trial. When relaxed this group performed better than the other groups.

It is possible that the gains during the experimental period and the subsequent absence of gains during the no treatment period are due to a novelty and its withdrawal. Equally possible, however, is the fact that increases are directly attributable to training. In a future study groups receiving one half year of training will be compared with groups who receive a full year of training. It is only through an experimental arrangement such as this that it could be determined whether the gains during training could be sustained, increased, or decreased.

It is quite clear, moreover, that children may be trained to preceive veridically and to organize their perceptions. The effect that this training has is to increase intelligence quotients and academic achievement. The transitory nature of the gains need not be construed as Hawthorne Effect necessarily. It does suggest rather that if students do make gains during block and reading training that were the training to continue, greater gains would be expected.

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